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Costa Rican orchids — I

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(WITH PLATES 7 AND 8)

In the months of April and May, 1906, Mr. William R. Maxon, of the U. S. National Museum, during a furlough from that institution, made, in the interests of the New York Botanical Garden, an exploration of portions of Costa Rica. Much attention was given to the collection of living plants, especially in the families *Cactaceae*, *Orchidaceae*, and *Bromeliaceae*, which furnished many specimens of great interest. The material was carefully collected and excellently packed, so that little harm came to it during the long journey, and it arrived in fine condition.

The orchids were especially well represented. Of many of these no herbarium material was secured, as at the time of collection they were not in flower. A number of these have now come into flower and others will undoubtedly do so, and it is the object of this and succeeding articles to report upon them.

Mr. Maxon gave, in the form of a report to the Director-in-chief of the Garden, an account of his explorations and many of the places visited by him, in the *Journal of the New York Botanical Garden* for August, 1906. As this may be inaccessible to many, the locations of some of the places referred to, which do not appear in the atlases ordinarily at hand, are given here, extracted in the main from Mr. Maxon's published account.

The country was entered at Port Limon, the eastern terminus of the Northern Railway of Costa Rica, which runs in a general westerly direction through the low lands of Siquirres, and then

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south and west along the gorge of the Rio Reventazon, traversing the region of Juan Viñas and Santiago. It then proceeds through Cartago to San José, the capital of the country, beyond which place Mr. Maxon did not proceed by rail. With this place as his base, excursions were made into the neighboring country, including the valley of the Rio Tirivi and the estate of La Palma, a few miles northeast of the city. While here a visit was made to Santo Domingo de San Mateo, at an elevation of about 300 meters, a little to the westward of San José, and the only locality visited west of that city. Mr. Maxon reports it as an exceedingly dry region at the time of his visit, but without a characteristic desert vegetation. A number of orchids were secured here, some of them of exceeding interest.

At Cartago, which has an elevation of about 1450 meters, considerable collecting was done, especially of living plants of orchids and bromeliads. Collections were also made at Santiago, a few miles to the eastward of Cartago. At Turrialba, on the border of the *tierra caliente*, some time was spent, and from that place a trip was made to the low humid forest on the border of the Rio Reventazon, at an altitude of about 600 meters. While at Cartago an excursion was also made to Coliblanco, an estate lying at the base of the volcano of Turrialba. One of the principal excurions while at Cartago was to the Finca Navarro, at an altitude of 1,350 meters. Navarro lies about seven miles to the southeast in a mountain valley a little lower than Cartago, at the junction of the Agua Caliente and the Rio Naranjo. Many of the orchids were secured at this point.

Judging from Mr. Maxon's collections and from recent publications, the orchid flora of Costa Rica must be exceedingly rich. It is to be hoped that explorations so well begun may be continued, for such continuation is certain to yield valuable results. Following are some of the orchids secured by Mr. Maxon, which may be safely reported upon at present.

CORYMBIS FLAVA (Sw.) Hemsley, Biol. Cent. Am. Bot. **3**: 297. 1884

Serapias flava Sw. Prod. 119. 1788.
Neottia flava Sw. Fl. Ind. Occ. **3**: 1417. 1806.

On moist forested slope, Finca Navarro, *no. 644*. Hemsley, *l. c.*, reports this from Mirador, southern Mexico, and from Chiriqui, Panama. Its detection in Costa Rica, therefore, was to be expected. Mr. Maxon in his field notes describes the flowers as yellow. This species was originally described from Jamaica.

PLEUROTHALLIS POLYLIRIA Endres & Reichenb. f. Gard. Chron. **32**: 1483. 1871

On tree bordering the Agua Caliente, Finca Navarro, *no. 702A*. This pretty species, one of the larger members of the genus, is a free bloomer, sending up usually several racemes from the same leaf. The flowers hang in a somewhat secund manner, giving the inflorescence an appearance resembling that of the lily-of-the-valley.

Originally described from fresh living material sent by W. W. Saunders to Reichenbach, who does not state from what country the plant was derived. A herbarium specimen, collected in Costa Rica by M. Endres, is, however, referred to as being the same, so that the indications are that that country is the native home of this interesting plant.

PLEUROTHALLIS MINAX Reichenb. f. Bonplandia **2**: 24. 1854

? Pleurothallis plumosa Lindl. Bot. Reg. **28**: Misc. 72. 1842.

On a tree bordering the Agua Caliente, Finca Navarro, *no. 707*. I have taken up with some hesitation Reichenbach's name for this plant, instead of that given by Lindley, who originally described the flowers as "green, with a little purple dotting on the inside," and gave the home of his plant as Trinidad. Later (*Folia Orch. Pleurothallis* 27. 1859) he makes this statement: "Flowers green in gardens, orange coloured wild," and refers to his species a specimen collected by Fendler in Venezuela, *no. 2152*, and also material secured by Wagener at Caracas. He further remarks thus: "The dissection of a flower of his *P. minax* given me by Prof. Rchb. and Fendler's specimens show that plant not to be distinct from *P. plumosa*." A specimen secured by Wagener at Caracas, at an elevation of 5000 feet, and presumably the one to which Lindley refers above, was the basis of *P. minax*. The plant which Mr. Maxon secured came into flower in the early part of November of

last year, the flowers being of a dull orange, thus closely approaching the "dottergelb" applied by Reichenbach in describing the color of the flowers of his species, and incidentally showing that the Costa Rican plants, at all events, do not produce green flowers in cultivation. So it does not seem possible to reconcile this with the green flowers originally accredited to *P. plumosa*, nor does it seem likely that a plant from Trinidad should be identical with one from an elevation, in practically the same latitude, of 5000 feet. The short velvety pubescence of the peduncle, axis of the raceme, bracts and flowers, and the color and details of the flowers, especially those of the lip, of *P. minax* so closely coincide with those in Mr. Maxon's plant that I cannot but place it there, rather than take up for it the name of *P. plumosa*, as done by Hemsley (Biol. Cent. Am. Bot. **3**: 201. 1883) for a specimen collected by Wendland, also in Costa Rica. Perhaps Lindley was wrong as to the color of his flowers, although he indicates that he was dealing with fresh material, or he may have been mistaken as to the country from which the material came — at all events, it seems better now to adopt for this Costa Rican plant a name which can be applied with some certainty, rather than a doubtful one. A comparison with Lindley's type may some time definitely settle the question.

ISOCHILUS LINEARIS (Jacq.) R. Br. in Ait. Hort. Kew. ed. 2. **5**: 209. 1813

Epidendrum lineare Jacq. Select. Stirp. Am. Hist. 221. *pl. 131. f. 1.* 1763.

Partially shaded rocky bank, Santiago, *no. 108.* Widely distributed in tropical America, but originally described from Martinique.

PONERA AMETHYSTINA Reichenb. f. in Saund. Ref. Bot. *pl. 93.* 1869

Santo Domingo de San Mateo. On tree-trunk by Rio Machuco, *no. 545;* and on tree trunk near Rio Grande, *no. 570.* This region is described by the collector as an exceedingly dry one but without a characteristic desert vegetation. An interesting find. The plant was originally figured and described from living material, secured by Mr. Skinner at Santa Fé de Veraguas,

Panama, which flowered in the collection of Mr. W. W. Saunders. Its detection in the above locality extends its range considerably to the north and west of its place of discovery. The flowers in our specimens have the sepals and petals more acute and the terminal lobe of the lip somewhat narrower than indicated in the plate referred to above, but they agree essentially in all the other particulars. The hollow at the base of the column, represented in the drawing and rather questionably referred to by Reichenbach, is quite manifest in the flowers of the Costa Rican plant. The lip, however, has no such hollow at the base, but, on the contrary, is noticeably thickened at that point.

EPIDENDRUM COCHLEATUM L. Sp. Pl. ed. 2. 1351. 1763

On trees in humid forest, Santiago, *no. 101*. On tree-trunk in forest, Turrialba, *no. 179*. Quite widely distributed in tropical America, ranging from southern Mexico to Venezuela, and common in the West Indies; also frequent in southern Florida.

The type locality is the Bahamas. Linnaeus appears to have had two things in his species. He gives three citations, as follows: Sloane, Jam. 250. *pl. 121. f. 2;* Catesby, Car. **2**: 88. *pl. 88;* and Plum. Pl. Am. Icon. *pl. 185. f. 2.* In his description he says: "nectario cordato." This effectually disposes of the first citation above, as that figure has a broadly obcordate or almost orbicular lip. The plant is figured, moreover, with very short round pseudobulbs, and has the sepals and petals represented as much broader and of a different shape than those in the plant commonly accepted as this species. The flowers are also described by Sloane as "reddish purple." One could hardly mistake this figure for what is commonly known as *E. cochleatum.* The other two figures cited represent what has been widely known as this species, that of Catesby being in color and allowing of no doubt. The lip is also decidedly cordate, as called for by Linnaeus, thus permitting us to retain the common conception of this species. Catesby's plant was from the Bahamas, and Plumier gives no origin for his, but cites Catesby's plate; the type locality is thus pretty clearly as indicated above.

EPIDENDRUM OCHRACEUM Lindl. Bot. Reg. **24**: Misc. 14. *pl. 26.* 1838

On trees in humid forest, Santiago, *no. 104.* First received by Lindley from the garden of Sir Charles Lemon, who received the living material from George U. Skinner, who had collected it in Guatemala. It is widely distributed in Central America.

EPIDENDRUM PALEACEUM (Lindl.) Reichenb. f. Beitr. Orch. Cent. Am. 80. 1866

Dinema paleaceum Lindl. Bot. Reg. **26**: Misc. 51. 1840.
Epidendrum auritum Lindl. Bot. Reg. **29**: Misc. 4. 1843.

On branches of fallen tree-tops, Turrialba, *no. 164.* Rather extensively distributed from Guiana to southern Mexico, and originally described from Guatemalan material. This is the second time this little species has been brought to us by collectors; Mr. Percy Wilson secured it in Honduras in 1903. It is interesting to note that Wendland also obtained specimens of this plant at Turrialba in 1857.

LAELIA RUBESCENS Lindl. Bot. Reg. **26**: Misc. 20. *pl. 41.* 1840

Under cultivation in the garden of Mr. P. Biolley, at San José, *no. 358.* Mr. Biolley secured the plant in January of the same year at Uricuaja, on the Pacific coast, at an altitude of about 200 m. When this species was first described its native country was unknown, but it was supposed to be Mexico, a supposition which was later verified. Owing to the variability of its flowers and pseudobulbs, two species described subsequently by Lindley, *L. acuminata* and *L. peduncularis*, are usually referred here. Under this broad conception it ranges from Mexico throughout Central America to Costa Rica.

EPIDENDRUM STAMFORDIANUM Batem. Orch. Mex. & Guat. *pl. 11.* 1838

On horizontal branch of a tree, Santo Domingo de San Mateo, *no. 600A.* This came mixed with a fine plant of *Schomburgkia* sp. (*no. 600*). Another specimen, *no. 355*, which was under cultivation at San José, was also secured from Mr. P. Biolley, in whose

garden at that place it was. Mr. Biolley secured it at Uricuajo, at an altitude of about 200 m., on the Pacific coast, in January of the same year.

The species was originally found by George U. Skinner along the shores of Lake Izabal, near Izabal, Guatemala. He sent plants in 1837 to England, where they flowered the following year, furnishing the material from which the original description and illustration referred to above were drawn. The flowering of this plant caused considerable excitement among the orchidologists of that day, as it was the first member of the genus known in which the inflorescence was not borne at the apex of the leafy stem. In this species, as well as in several others, the inflorescence is borne upon a leafless stem arising from the base of the leafy pseudobulb.

Mr. Skinner remarks (Batem. Orch. Mex. & Guat. *l. c.*) that the plant is known in its native country as "quartorones," in allusion to the four colors of its blossoms. The flowers of the plants which have blossomed in the New York Botanical Garden have undergone remarkable changes in color as they faded, the white of the lip passing into yellow and buff, and various combinations of these, produced by stripes, spots and blendings.

Elleanthus caricoides sp. nov. (PLATE 7)

A densely tufted plant, smooth and glabrous with the exceptions noted below, with numerous gracefully drooping slender stems. Stems 4 dm. long or less, round, about 1.5 mm. in diameter at the base, sparsely spotted with purple: leaves 5–7; sheaths grooved, much shorter than the blades, spotted with purple, the lower 2 or sometimes 3 soon turning brown, bladeless or with but rudimentary blades; blades flat, about 7-nerved, erect, somewhat twisted and recurved above the base, linear-lanceolate to linear, shining, long-acuminate at the apex, narrowed toward the base, 1–2 dm. long, the lowermost sometimes a little shorter and the one immediately below the inflorescence often but 4–6 cm. long, 7–8 mm. wide: inflorescence 2–3 cm. long, on a peduncle less than 1.5 cm. long, the bracts, the lowermost one of which is usually empty, ovate-lanceolate, green, apparently spirally arranged, long-acuminate, 2–3 times as long as the flower, nearly erect and somewhat recurved above the middle; flowers, including the ovary which is 2–3 mm. long and more or less appressed-pubescent with black-brown hairs, about 1 cm. long, gibbous on one side: lateral sepals 7–8 mm. long, about 3 mm. wide, oblong to oblong-oval,

rather abruptly contracted above into a laterally compressed and keeled apex, more or less pubescent on the back with black-brown deciduous hairs, about 5-nerved; dorsal sepal 5–6 mm. long, and about 2 mm. wide, the compressed apex much less prominent: petals oblong-linear, somewhat dilated at the rounded and apiculate apex, 6–7 mm. long, 1.5–2 mm. wide: lip nearly campanulate, completely surrounding the column so that its margins meet, about 7–8 mm. long, when spread out 10–12 mm. wide at the truncate and sparingly ciliate apex and 5–6 mm. wide at the base, a 2-ridged crest just below the middle, the two appendages near the base of the lip oblong, papillate, 1.5–2 mm. long and about 1 mm. wide: column 7–8 mm. long, 4-toothed at the broadened apex.

On the lower horizontal branch of a tree bordering the Agua Caliente, in the humid region, upon the Finca Navarro, *no. 692*.

CATASETUM MACULATUM Kunth, Syn. Pl. Aequin. **1**: 331. 1822

Cultivated at San José, *no. 352*. Another species which Mr. Maxon secured from Mr. Biolley, who secured it at San Mateo, on the Pacific coast. It flowered with us first on November 23 of last year. This material very closely agrees with the description of Kunth, also with the details of the figure published (H. B. K. Nov. Gen. & Sp. **7**: *pl. 630*). The parts are not so green as called for in that description, and this perhaps accounts for Mr. Maxon receiving the plant under the name of var. *luteopurpurata* Cogn., a name, however, of which I can find no record of publication. Mr. Percy Wilson, who visited Honduras in 1903 in the interests of the New York Botanical Garden, also obtained living material of the same species which has flowered at the Garden.

Catesetum maculatum was found first near Turbaco, Colombia, at an altitude of about 324 m. I cannot think, however, that the *C. maculatum* of Bateman (Orch. Mex. & Guat. *pl. 2*) is the same thing, for the setae of the column are described and figured as very short, quite different from the very long ones in the true *C. maculatum* Kunth. The *C. maculatum* of Lindley (Bot. Reg. **26**: *pl. 62*. 1840) seems to be different also; the color of the flowers is quite different and the petals are entire, while in the plants from Costa Rica and Honduras these parts are decidedly serrated, thus agreeing with the original description of Kunth.

CYCNOCHES ROSSIANUM Rolfe, Gard. Chron. **69**: 456. 1891

On tree-trunk at border of forest, vicinity of Rio Reventazon, Turrialba, *no. 172*. A most interesting find. Rolfe drew his description from material secured from a plant which flowered in the collection of Signor H. J. Ross, Poggio Gherardo, Florence, Italy, in 1889. This plant was purchased for *C. Warscewiczii*, quite another species with pure green staminate flowers, represented by a living plant in the collections of the New York Botanical Garden. The native country of the original plant of *Cycnoches Rossianum* was not known, and it is interesting to have its home thus revealed. The plants which Mr. Maxon brought back with him have produced up to the present time only staminate flowers, which agree with the description given by Mr. Rolfe.

The staminate racemes are long and slender, in the Costa Rican plant measuring up to 6 dm. long with the flowers rather scattered. The sepals and petals are yellowish-green, heavily blotched with purple-brown, as described by Rolfe, who says further that the pistillate raceme he examined had but a single flower which was about twice the size of the staminate flowers and of a uniform green color with a slightly darker shade on the lip.

XYLOBIUM FOVEATUM (Lindl.) Stein, Orchideenb. 597. 1892

Navarro, *no. 674*. This was originally described from plants secured in Demerara. Cogniaux (Mart. Fl. Bras. 3^5: 470) gives its range as extending to Venezuela, Peru and Colombia. While the Costa Rican material differs somewhat from the South American plant, judging from descriptions, it seems best for the present to refer it to the same species.

Maxillaria Valenzuelana (A. Rich.)

Pleurothallis Valenzuelana A. Rich. in Sagra, Hist. Cuba **11**: 234 1850.

Dicrypta iridifolia Batem.; Loud. Hort. Brit. Sec. Add. Suppl. 630. 1839. Name only.

Maxillaria iridifolia Reichenb. f. Bonplandia **2**: 16. 1854.

On tree trunk, Cartago, *no. 53*. Cogniaux (Mart. Fl. Bras. 3^6: 78) gives the distribution of this plant as extending from Brazil to Colombia and Cuba. Its discovery in Costa Rica therefore extends the range to the continent of North America.

As indicated above in the synonymy, the first name applied to this plant is a nomen nudum ; the origin of the plant was attributed to Trinidad. The first adequately published name seems to have been *Pleurothallis Valenzuelana*, described from Vuelta de Abajo, western Cuba. Reichenbach, *l. c.*, states that his plant came from Cuhobas, Cuba, and indicates that it was collected by Pöppig. Pöppig employed his time as a botanical collector and physician, his botanical activities being principally confined to Matanzas and S. Elena, near Cahoba and the territory to the south and the southwest (Urban, Symb. Ant. 1 : 130). The type locality of this plant is, therefore, whether one adopt the name of Richard or that of Reichenbach, western Cuba.

Zygostates costaricensis sp. nov. (PLATE 8)

Plant grayish-green. Stem very short : leaves grayish-green ; lower ones widely spreading, the upper ones ascending to erect ; sheaths equitant, 1–2 cm. long, their margins hyaline ; blades articulated to the sheath, inequilaterally lanceolate or oblong-lanceolate, sometimes slightly falcate, acute, laterally compressed, 1.5–4 cm. long, 4–10 mm. wide : inflorescence axillary, racemose, the rachis densely hispid with spreading hairs of variable length, the spreading bracts, both those at the base of the rachis and those subtending flowers, broadly ovate to orbicular, acute, about 2 mm. long, partly clasping the rachis, ciliate on the margin with glandular hairs : flowers not crowded, on hispid pedicels which are shorter than the bracts : sepals free, orbicular, wing-keeled on the back, about 2 mm. in diameter, obtuse, the keel ciliate with a few teeth, the body of the sepals on the back sparingly hispid : petals orbicular, about 2 mm. long including the short claw, keeled and sparingly hispid on the back : lip papillose, incurved and arching over the flower, concave, 4–5 mm. long when straightened out, green at the base, slightly dilated above where it is about 1 mm. wide when spread out, acute at the apex : the 2 appendages about 1 mm. long, spreading like a ram's horns, white, papillose, flattened, somewhat dilated toward the obtuse apex : column very slender and weak, bent back, geniculate, the rostellum with a long crooked beak which is recurved into a semicircle about the middle : anther of the general shape of the rostellum and somewhat exceeding it in length, and with a recurved tip : pollinia 4, on a long slender stipe which is bent back upon itself toward the apex.

On tree-trunk in forest, Finca Navarro, *no. 680*. The most interesting plant revealed thus far in Mr. Maxon's collections.

The herbarium material of this plant brought back still had the old racemes attached, but all the flowers were missing, so it was impossible to place it satisfactorily. Fortunately Mr. Maxon succeeded in securing some good living plants. These throve and came into flower in October of last year. This supplied the needed material for a definite determination of the plant. It was interesting to find that it belonged to the genus *Zygostates*, known hitherto only from Brazil and Paraguay, and that it was also an undescribed species. Another genus is thus added to the orchid flora of North America.

Zygostates is closely related to *Ornithocephalus*, which ranges from northern South America and Trinidad through Panama and Central America, with one or two outlying species in Asia and Australia. It is distinguished from *Ornithocephalus* by the two appendages near the base of the column. The structure of the column and the unusual lip of this Costa Rican member of the genus differ considerably from the same organs in other species of the genus, but it seems best, at least for the present, to refer it here.

WARSCEWICZELLA WENDLANDII DISCOLOR Reichenb. f. in Warn. & Will. Orch. Alb. **3**: *pl. 126.* 1884

On trees in humid forest, Santiago, *no. 105;* on tree-trunk, Cartago, *no. 55*. This interesting color-variation, in which the sepals and petals are pale-green instead of white, was first noted in a plant that flowered in the collection of Mr. A. H. Smee, in England. It is a very desirable plant, as it flowers freely, and for a long period. The contrast of the lavender of the lip with the pale-green petals and sepals is most effective. It also has the added value of a pleasant perfume.

NEW YORK BOTANICAL GARDEN.

Explanation of plates 7 and 8

PLATE 7. ELLEANTHUS CARICOIDES Nash

1. Apex of stem, natural size. 2. Flower, dorsal view, × 3. 3. Flower, lateral view, × 3. 4. Sepals, × 3. 5. Petals, × 3. 6. Lip, × 3. 7. Lip, spread out, × 3. 8. Column, anterior view, × 3. 9. Column, lateral view, × 3. 10. Pollinia, × 8.

PLATE 8. ZYGOSTATES COSTARICENSIS Nash

1. Plant, natural size. 2. Flower, lateral view, × 16. 3. Flower, from above, × 8. 4. Sepal, × 16. 5. Petal, × 16. 6. Appendages, column and anther, × 16. Anther, from below, × 16. 8. Anther, from above, × 16. 9. Pollinia, × 16.

An occurrence of glands in the embryo of Zea Mays

CHARLES STUART GAGER

The embryo of the grasses is an ancient battle-ground. Controversies over the homology of its various parts, and over their several functions, have been waged almost continually since the last half of the seventeenth century, when Malpighi[6] first described its anatomy. Its study formed part of the basis on which Schleiden[9] and Schacht[8] concluded that plant embryos originate in the end of the pollen-tube, while the embryo-sac serves only to protect and nourish them. By its study, in part, Mirbel and Spach,[7] and Brongniart[1] were led, on the other hand, to a diametrically opposite conclusion, namely, that the embryo originates in the embryo-sac, and that only after fecundation by the pollen.

The battle has waged fiercely over the indentification of the true cotyledon. The term scutellum (little shield), merely descriptive, harks back to Gaertner,[3] in 1788. His studies on the fruits and seeds of plants were considerably colored by his investigations of the eggs of animals, and he interpreted the shield-shaped organ in the grass embryo to be analogous to the vitellus, or nutritive part, of the animal egg. Hence he referred to it as "*vitellus scutelliformis*," or, briefly, *scutellum*. That he recognized it as really homologous with the cotyledon in other families is evidenced by the term "*scutellum cotyledoneum*" which he also employed.*

The literature shows some diversity in the significance with which the term scutellum is employed. Most authors use it, as Gaertner originally did, to apply to the entire organ, but at times its meaning has been narrowed† to the outer layer of cells, or epithelium of the shield. There seems to be little warrant and small gain in this latter restriction of it use, and the practice should be discouraged.

* "Singularem hanc Vitelli speciem, proprio *Scutelli cotyledonei* nomine distinguimus." Gaertner[3] (page cxlix).

† Brown and Herron. Jour. Chem. Soc. Lond. Trans. **35** : 623. 1879.

A discussion of the various interpretations that have been given since the time of Gaertner as to the homology of its parts, would not be germane to this paper.* Goebel,[4, 5] in 1895 and 1900 on the basis of Bruns's[2] work and of his own study of *Streptochaeta*, interprets it as a true cotyledon, while "the epiblast, which lies over against it, but is not present in all grasses, is an arrested leaf," and the coleoptile, or sheath of the plumule, is the third leaf. The first green leaf is the fourth leaf of the plant. Thus the view most generally held at the present time closely agrees with that put forward by Malpighi in 1675.

Questions of function have been fully as puzzling as those of structure, if not more so, and this, too, notwithstanding the opportunities for solution by the method of experiment.

As early as 1845, Schleiden[53] regarded the scutellum of the oat as an organ of absorption, and was followed in this view by Schacht[52] and Sachs.[48, 49] It was Sachs who first pointed out the fact that the embryo, in its earlier stages of development, lives as a parasite on the endosperm, and we owe to him the term "absorptive epithelium," as applied to the outer layer of cells of the scutellum.

Three principal regions are concerned in the nourishing of the germinating embryo. These are the scutellar epithelium, the aleurone layer, and the remaining cells of the endosperm.

Dutrochet had shown that starch, as such, could not pass through semi-permeable membranes, like the cell-walls of plants, by osmosis, and thus the conclusion was forced that the food stored in the endosperm must be transformed before it could become available to the awakened embryo.

The earliest idea to develop in this connection was that the effective agent in this transformation was gluten. Fabroni, in 1785, is said † to have isolated from grape-juice a gluten-like, adhesive matter, without which fermentation did not take place. Thenard,† experimenting with several fruits, confirmed Fabroni's experiment, and considered the glutinous matter, isolated by filtering fruit juices, as identical with yeast. Thus the attention of chemists and physiologists was naturally directed to gluten as indicated above.

* The different theories have been discussed by Van Tieghem.[10, 11, 12]

† Cited by Thomson[55] (1818), page 291.

In the same year (1785), Irvine[30] pointed out the fact that, in malting, not only did the malt become sweet, but the endosperm of crushed seeds, when mixed with the malt, also became converted into sugar.

Further advance seemed to await the discovery, by Colin and Claubry,[19] in 1814, that starch is colored blue by iodine.* This discovery became a great aid in endosperm studies.

In the following year Kirchhoff,[31, 32] on the basis of his experiments, concluded that the gluten accomplishes the formation of sugar in germinating seeds, and in farina that has been scalded with hot water. He also stated that the gluten attains through germination the property of transforming into sugar a much greater quantity of starch than is to be found in the seeds, and further clearly saw that the production of sugar in germinating seeds is a chemical process, and not a consequence of vegetation.

Experiments of a similar nature to those of Kirchhoff led Thomson,[55] in 1818, to the extreme view that the essential constituent of yeast is "a species of gluten," and "that it is some substance connected with the gluten that acts upon the starch, and converts it into sugar.

The studies of Proust[43] and of Saussure,[50] in 1819, and of Dombasle,[20] in 1820, on the conversion of starch to sugar by the action of gluten, contributed only slightly to the solution of the real question, but thirteen years later, in 1833, Biot and Persoz[13] announced the discovery of dextrine, which they had produced from starch by the influence of acids.† Vogel,[58] by similar means, had, in 1812, produced what was probably the same substance, but its name and the recognition of its true nature must be attributed to Biot and Persoz.

Previous to this, Braconnot,[15] in 1824, isolated a "special principle" which changed to sugar the starch from tubers of *Helianthus tuberosus*, and in the same year in which dextrine was discovered, Saussure[51] isolated from wheat endosperm a substance similar to Braconnot's "special principle," and which alone could

* Scholz (Jour. für Chem. und Phys. **12**: 349. 1814. Footnote) attributes this discovery to Stromeyer, but gives no citation.

† Raspail,[46] who discovered the mark, or "hilum" on starch-grains, stated his belief in 1826, that "the carbonic-acid of the air is sufficient to effect the transformation of starch to sugar" (page 335).

convert into sugar four times its weight of starch. These studies, and that of Payen,[35] in 1824, paved the way for the discovery of diastase by Payen and Persoz[38] in 1833. This substance, its discoverers announced, could convert into dextrine 2,000 times its own weight of starch.

Later (1843, 1846) Payen[36, 37] demonstrated that starch must be altered "by water and diastase" before it can pass through cell-walls, and that only after being thus altered can it pass from tissue to tissue. The question now became, What is the source of the diastase by which, in germination, the endosperm is digested?

Raspail[45] had shown, in 1825, that, in germination, the endosperm gradually lost its starch, while the enlarging embryo became gradually enriched with starch-grains, and, in 1862, Sachs[48] observed that, in the germination of grass-embryos, the change of starch to sugar "begins on the side of the endosperm which lies next to the absorbing scutellum." He also demonstrated that the products of the solution of the endosperm are translocated to the germ, and homologized the scutellar epithelium "with the organ of the same name on the cotyledons of palms, and with the young epidermis of the *Ricinus* cotyledon . . . ."

From this time on, beginning with Bloziszewski,[14] in 1875, there have followed a number of researches on the germination of grass embryos deprived of endosperm, and on the ability of isolated embryos to utilize artificial endosperm. Among the earlier and more extensive of these investigations, are those of Brown and Morris,[16, 17] who demonstrated in 1888 the possibility of growing grass embryos on artificial endosperm, and, in 1890, showed that, at the beginning of germination, starch first reappears in the cells of the scutellum immediately under the epithelium. Its first appearance here, being coincident with the earliest stages of the depletion of the endosperm, was taken as evidence that it came from the latter.

The fundamental investigations as to whether or not the diastase could diffuse through cell-walls and, therefore, would not necessarily have to be secreted by the cells where it is to act, was not made until 1894, when Grüss,[23] with results contrary to those of Krabbe,[33] in 1890, demonstrated the possibility of such diffusion.

The work of Grüss indicated that the statement of Brown and Morris (1890), "that the disappearance of the cell-wall always precedes any visible attack upon the contained starch granules," is not true in all cases.

It would lead too far afield to review in detail the subsequent literature upon this topic. Experimental researches have led to at least five different views as to the place of origin of the digestive ferment during the germination of grasses. They may be briefly summarized as follows:

1. *The cells of the aleurone layer chiefly secrete the diastase*, which acts on the starch in the endosperm. This is the statement, in a more modern terminology, of the old view that starch is turned to sugar by gluten. It was tacitly assumed by Tschirch,[57] in 1889 (page 181, legend of *f. 63*).*

2. *The epithelium of the scutellum is the principal secreting layer*. This is the view of Brown and Morris,[16] in 1890,† of Grüss,[22] in 1893 (page 291), and, by implication, of Reed,[47] in 1904. According to Brown and Morris, a diastase that dissolves cell-walls is also secreted by these cells.

3. *The endosperm is the main source of the ferment*, according to Green[21] (1890), Krabbe[33] (1890), and Linz[34] (1896). "The diastase," says Krabbe, "is generally not translocated, but develops directly at the place of its activity." Secretion by the endosperm results "in consequence of some kind of stimulus on the part of the seedling." This last assertion was contradicted by Pfeffer[39] in 1893. Linz[34] definitely states (page 301), "that the epithelium of the scutellum of the seed of maize is not in a condition to secrete ferment, [and] that the epithelium is rather an apparatus which serves for the absorption of dissolved nutriment." Further on (page 318) he says, "The aleurone layer is not the source of the diastase which appears in the endosperm during germination."

4. *The scutellum and the endosperm secrete diastase*, but not so

* The notion that pure gluten can change starch to sugar is now, of course, demonstrably erroneous, but whether or not the cells of the gluten- or aleurone-layer in the grass-fruit can secrete a diastatic ferment is a different question.

† Brown and Escombe[18] (page 14) demonstrate the hydrolytic capacity of aleurone-cells of barley, the capacity of this layer for endosperm-depletion, and that such capacity on the part of the endosperm-cells is very probable.

the aleurone layer. This view is stated by Pfeffer,[40] in 1900, (page 599), who calls the diastase secreted by the scutellum "accessory diastase," and says its secretion may always be regulated by the needs of the plant. This conclusion is based in part upon the experimental demonstration that isolated bits of endosperm placed in contact with water become spontaneously depleted. In these experiments, the disappearance of the starch proceeds centripetally from the surface of the endosperm in contact with the water.

5. *All storage tissues are capable of auto-depletion*, according to Puriewitsch.[44] This conclusion was based upon studies of the endosperm and cotyledons of various seeds, and the contents of roots, bulbs, rhizomes, tubers, and other stems. In 1896 Grüss[25] states that "It is well known that the endosperm cells themselves secrete a ferment during germination" (pages 408, 422). This, together with his paper of 1895, indicates that his position then should be classed here, but in 1897 (page 664) he says: "Seedlings from which one has taken the endosperm may, without the aid of bacteria, nourish themselves upon starch paste, which thereby becomes changed to sugar." This, however, does not necessarily imply a change from his preceding position.

In addition to the above views, may be mentioned that of Wigand,[59] who in 1888, attributed a diastatic function to the aleurone layer, but only through the mediation of bacteria developing in it; and Hansteen's,[29] founded upon extensive though insufficiently guarded experiments, that it is not necessary for diastase to proceed from the scutellum during germination.

In 1890, Haberlandt[26] stated (page 48) that "The aleurone layer of the grass-endosperm, and presumably also of seeds of other plants, is henceforth to be classed with the digestive glands of insectivorous plants," and in 1904 he states (page 477) that "its histological structure, in connection with the experimental fact that the isolated gluten layer richly secretes diastase, forms the ground for my notion concerning the function of that layer." It is interesting to note that, in this last mentioned work, the pendulum has swung back to the original idea, advanced by Kirchhoff ninety years previously, that in germinating seeds the gluten is a source of the agent that changes starch to sugar. It hardly seems probable that Haberlandt's view will finally stand.

The work of Brown and Morris indicates that the endosperm of the grass fruit is dead, but the only inference warranted by the papers of Green, Krabbe, Hansteen, Pfeffer, and Linz is, as Linz definitely states (page 312), that it is alive.

The most obvious conclusion to be drawn from this review of the literature is that there is still need for further careful experimental investigation of the subject, in which every precaution shall be used to exclude bacterial contamination, and other sources of error. Such work has been done with the date seed by Pond,[42] whose experiments seem to leave little doubt that the date-endosperm, at least, is incapable of self-digestion.*

The facts of teratology have frequently thrown light upon normal structure, helping to establish the homology of an organ whose interpretation would otherwise remain in doubt. From the fact that structure is an expression of function, anatomical variations in the direction of a structure whose rôle is well understood, may quite justifiably be taken, in connection, of course, with other facts, as evidence of the probable function of the part that varies. It was with considerable interest, therefore, in the light of our present knowledge of the homology and physiology of the parts of the fruit of the *Gramineae*, that the writer, in an examination of cross-sections of the corn grain, observed a variation in the scutellar epithelium, the significance of which can scarcely be questioned.

This tissue, one cell thick, and variously called the "absorptive epithelium" and the "glandular epithelium," is, as is well known, clearly defined anatomically from the adjacent tissue on either side. The shape of its cells, narrow and oblong in section, their palisade arrangement, and the appearance of the protoplasm, granular and relatively dense in the resting seed, more vacuolated as germination begins, and with a well defined, vigorous nucleus, clearly distinguish it. Normally it forms an unbroken layer over the convex surface of the scutellum.

In the sections examined, this layer was found invaginated in places, in such a way as to form small pockets or sacs in the tissue of the scutellum. On one side there were two such structures, and on the other side one, with a slight suggestion of an unfinished

* A conclusion contrary to that reached by the same author [41] in 1904, when there was failure to observe certain necessary precautions of method.

fourth. The diagram (FIGURE 1), shows the location of these structures in the scutellum, while they are shown in detail in the photomicrographs, FIGURES 2 and 3. Two of them, as may be seen in the diagram, are of practically uniform diameter throughout, while the other and larger one is enlarged at the end.

Describing the scutellum of the corn in 1902, Torrey[56] says: "At the region of the tip this secretory epithelial layer dips down at frequent intervals into the scutellum. The convolutions so produced secure a larger surface of secretion where there is greatest need for the enzyme; for the endosperm is thickest at this point and in front of the embryo." Whether the structures seen by Torrey were the same as those described above is not entirely clear from his description, but his figure (*f. 1*) indicates that they were at least very similar. If so, their location is not restricted "to the region of the tip" of the scutellum, as is clearly shown in

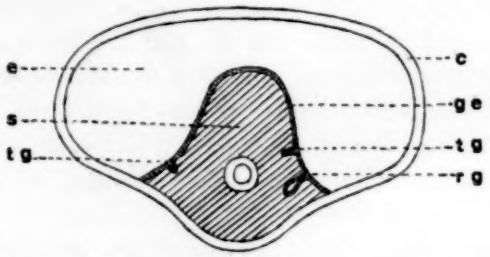

FIG. 1. Diagram of cross-section of grain of *Zea Mays*. *c*, combined coats of fruit and seed; *e*, endosperm region; *s*, scutellum; *ge*, glardular epithelium; *tg*, tubular glands; *rg*, gland slightly racemose.

FIGURE 1 herewith. Thus their distribution does not seem to be correlated with the thickness of the endosperm.

What is their significance? The variety of the corn is the "Hickory King," of J. M. Thorburn & Co., and the grains are of uniformly large area, though relatively flat and thin. Because of these facts it may be suggested, not unreasonably, that this invagination of the epithelium is merely an expression of vigorous, rapid growth, without corresponding opportunity for expansion. An analogy is found in the uneven, crinkled surface of foliage-leaves in many plants, due to the fact that one epithelium has grown more rapidly than the other. The wrinkling is a "mechan-

ical necessity." This suggestion, I think, may be dismissed at once as having too little warrant in the facts, and as being less probable than another.

If the scutellar epithelium is primarily an organ for the absorption of nutriment, as Sachs held, the variation described would be even more surprising, for we should reasonably expect an evagination, or haustorial-like projection of the tissue into the endosperm, rather than an invagination, especially if the conception of the intimate relation between structure and function is valid.

If, however, we have to deal here with an epithelium whose chief function is secretion, then the variation described is one that might

FIGURE 2

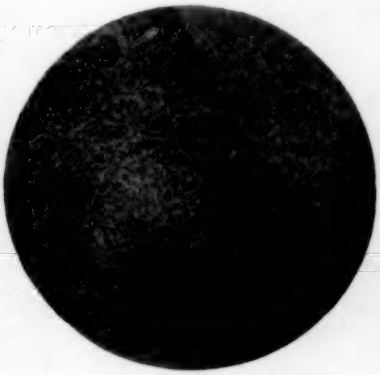

FIGURE 3

FIG. 2. Photomicrograph of cross-section of grain of maize. Tissue of scutellum at left, tissue of endosperm at right. Showing two glands in the scutellum.

FIG. 3. Photomicrograph of the upper gland of FIGURE 2, more highly magnified

have been predicted, and when once seen, the greater surprise would be that it was not of more frequent occurence. The first impression, that the anomalous structures are glands, is only strengthened by more careful observation and more thoughtful consideration. Any anatomist would at once classify the smaller invaginations as tubular glands, the simplest secreting structure next to the glandular epithelium, while the larger sac more nearly resembles a simple racemose gland.

Evidence of secretory activity was not sufficient in any part of the sections to throw light on the function of these structures. Their function may be inferred only from their anatomy, in the light of other well-known physiological observations.

Obviously no inference may be drawn from this anomaly as to the normal or the possible functions of the endosperm cells, nor of the cells of the aleurone layer, nor may any definite conclusion be drawn, on this basis alone, as to the proper function of the tissue involved. The weight of the evidence, however, is in line with all the facts of anatomy and experimental physiology which indicate that the scutellar epithelium of the grass embryo is an organ of secretion, a true glandular epithelium.

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American fossil mosses, with description of a new species from Florissant, Colorado

ELIZABETH GERTRUDE BRITTON AND ARTHUR HOLLICK

(WITH PLATE 9)

During the summer of 1906 Professor Theo. D. A. Cockerell and his wife spent several weeks at Florissant, Colorado, collecting fossil plants. Among those collected was found a beautifully preserved fruiting tuft of a moss, which was kindly transmitted to us for examination and description. The specimen was obtained from the well-known Tertiary shales of that locality, from which quantities of fossil insect and plant remains have been secured by many different collectors from time to time; but among the thousands of specimens thus brought to light only three have been heretofore described as mosses, viz.

Hypnum Haydenii Lesq. Ann. Rept. U. S. Geol. and Geog. Surv. Terr. **1874**: 309. 1876; Bull. U. S. Geol. and Geog. Surv. **1**: 583. "1875" [1876]; Rept. U. S. Geol. Surv. Terr. **7** (Tert. Fl.): 44. *pl. 5. f. 14, 14a, 14b.* 1878. (PLATE 9, FIGURES 1, 1a.)

Fontinalis pristina Lesq. Rept. U. S. Geol. Surv. Terr. **8** (Cret. and Tert. Fl.): 135. *pl. 21. f. 9.* 1883. (PLATE 9, FIGURES 2, 2a.)

Hypnum Brownii Kirchner, Trans. Acad. Sci. St. Louis **8**: 178. *pl. 12. f. 4, 4a.* 1898. (PLATE 9, FIGURES 3, 3a.)

None of these, however, is a fruiting specimen, and the generic determinations were based entirely on the leaf-characters, which, even if well defined, would not in themselves be characters from which generic or even family relationships could be satisfactorily determined. In this connection it may be suggested that the species first mentioned is more indicative of a *Lycopodium* or a conifer than of a moss, and the author voices his uncertainty in acknowledging that "the apparently thick leaves seem abnormal for a species of

moss," and that "the mode of division . . . separates it from the Lycopods." *

In regard to the second species cited it may be merely remarked that the correctness of its reference to the genus *Fontinalis* is questionable, so far as may be judged by the figures, while in regard to the one last mentioned the author, in his description, says: "The leaves in most cases are indistinct and only the more solid stems are discernible." It is apparently a moss, but satisfactory evidence of its relationship with the genus *Hypnum* is not apparent in the figures.

The only other American fossil-plant remains described as mosses, with the exception of several existing species from deposits of Pleistocene and more recent age, are *Hypnum columbianum* Penhallow, in Dawson, Trans. Roy. Soc. Canada **8**[1]: 77. *fig. 3.* 1890 (PLATE 9, FIGURE 4), from lower Tertiary beds at Quesnel, B. C., which is more likely a conifer, apparently related to *Widdringtonia helvetica* Heer, Fl. Tert. Helv. **1**: 48. *pl. 16, f. 2–18*, or to *Glyptostrobus Ungeri* Heer, as depicted by several authors; and *Rhynchostegium Knowltoni* E. G. Britt., described and figured in Bull. Torrey Club **26**: 79, 80. 1899 (PLATE 9, FIGURE 5), from the upper Eocene or Miocene sandstone at Cle Elum, Kittitas County, Washington. These specimens, as in the case of those previously mentioned, are also sterile, so that in our specimen from Florissant we have the first fossil moss with fruit thus far recorded from America.

Glyphomitrium Cockerelleae sp. nov.

(PLATE 9, FIGURES 6, 6a)

Plants pulvinate, forming a dark-brown tuft 1 cm. high and 2.5 cm. wide, with lignitic remains appearing like a mass of dark-brown radicles. Stems erect and crowded, evidently branching: leaves

* Through the kindness of Dr. J. N. Rose, Associate Curator of the Division of Plants, U. S. National Museum, the type specimen of *Hypnum Haydenii* was transmitted to us for examination, from which our figures were made. We are satisfied that it is not a moss, and Dr. L. M. Underwood, of Columbia University, has expressed his opinion that it can not be a *Lycopodium*. The closest comparisons which we have been able to make are with certain conifers, especially with forms of *Juniperus communis* L., in which the young growing branchlets often present a striking similarity in general appearance to this specimen.

2–3 mm. long, linear-lanceolate, straight or curved, apparently with a thick vein and slender sharp apex: sporophytes terminal: seta erect and straight, 1–1.5 cm. long: calyptra mitrate and plicate, 2–2.5 mm. long, with well-marked ridges forming darker grooves in the light-colored stone.

The capsules were not yet developed when this specimen was buried and nothing but the calyptra remains to indicate the nature of the sporophyte, but from general aspect and characters it seems to belong nearest to the *Grimmiaceae* with a resemblance to the *Ptychomitrieae*, the calyptra being grooved and long, completely enclosing the sporophyte when young, as in *Ptychomitrium*, and prolonged into an acute apex as if the lid were rostrate.

This species is dedicated to Mrs. Wilmatte Porter Cockerell, in recognition of her devotion to science and her invaluable assistance in securing specimens from this locality.

This genus has been known in American bryological works as *Ptychomitrium*, but the older name has been reinstated by Brotherus in Engler & Prantl, Pflanzenfamilien (**1**[3]: 440. 1902) while keeping the name of the section, as indicated above. The synonymy is as follows:

Glyphomitrium Brid. Mant. 30. 1819; emend. Mitt. Jour. Linn. Soc. **12**: 105. 1869.

Brachysteleum Reichenb. Consp. 34. 1828.

Ptychomitrium (Bruch) Furnr. Flora 1829, Erg. 2: 19. 1829.

Notarisia Hampe, Linnaea **11**: 379. 1837.

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Explanation of plate 9

Figs. 1, 1*a* — *Hypnum Haydenii* Lesq.
Fig. 1 × about 1⅔.
Fig. 1*a* × about 2.
Figs. 2, 2*a* — *Fontinalis pristina* Lesq.
Fig. 2 natural size.
Fig. 2*a* × about 1½.
Figs. 3, 3*a* — *Hypnum Brownii* Kirchner.
Fig. 3 natural size.
Fig. 3*a* × about 5 (?).
Fig. 4 — *Hypnum columbianum* Penhallow. Natural size.
Fig. 5 — *Rhynchostegium Knowltoni* E. G. Britt. × about 9.
Figs. 6, 6*a* — *Glyphomitrium Cockerelleae* E. G. Britt. and Hollick
Fig. 6 × about 1⅔.
Fig. 6*a* × about 7.

Studies in the North American Convolvulaceae. III. Calycobolus, Bonamia, and Stylisma

Homer Doliver House

The *Dicranostyleae*, to which belong these three genera together with *Cressa* and *Evolvulus*, is characterized by bifid styles and these divisions sometimes again cleft, as in *Evolvulus*, valvular and usually 2-celled, 2–4-seeded capsules. The genus *Calycobolus* (*Prevostea*) has been placed in the *Poraneae* by Hallier, but the characters of the style and capsule in *Calycobolus* are those of the *Dicranostyleae*, while the only character which it has in common with *Porana* is the inequality of the sepals. The genus *Dicranostyles* Benth. is represented in northern South America by *D. scandens* Benth., and the closely allied genus *Lysiostyles* Benth. by *L. scandens*.

Key to the North American Genera of Dicranostyleae

Outer sepals enlarged, often colored or otherwise different from the inner sepals. 1. Calycobolus.

Sepals alike or nearly so.

Divisions of the style entire; stigmas 2; corolla funnelform.

Stamens included.

Plants comparatively stout; sepals leathery, rounded or obtuse. 2. Bonamia.

Plants slender; sepals herbaceous, acute or acuminate. 3. Stylisma.

Stamens exserted. 4. Cressa.

Divisions of the style each 2-cleft; stigmas 4. 5. Evolvulus.

1. CALYCOBOLUS Willd.; R. & S. Syst. 5: 4. 1819

Twining or suberect, herbaceous or woody plants. Leaf-blades petioled, entire, rarely cordate. Flowers in axillary clusters. Sepals unequal, the outer ones enlarged and differing from the inner in texture, shape, color and sometimes insertion. Stamens included; filaments dilated and pubescent at the base. Ovary 2-celled, 4-ovuled. Style bifid nearly or quite to the ovary, the divisions unequal. Stigmas 2, small, capitate. Capsules ovoid. Seeds smooth or pubescent.

Type species: *Calycobolus emarginatus* Willd. *l. c.* = *Dufourea sericea* H.B.K. = *Prevostea sericea* Choisy.

Dufourea H.B.K. Nov. Gen. & Sp. **3**: 113. 1818. Not *Dufourea* Bory, 1810.

Prevostea Choisy, Ann. Sci. Nat. **4**: 497. 1825. — Mém. Soc. Phys. Genèv. **6**: 492. 1833.— In DC. Prodr. **9**: 437. 1845.

Reinwardtia Spreng. Syst. **1**: 527. 1825. Not *Reinwardtia* Dum. 1822.

Wilberforcia Hook. f.; Planchon, in Hook. Ic. *pl. 796*. 1848.

At least eight species are known, two in Mexico and six in South America. Of the South American ones, the type of the genus, *C. sericeus*, may extend into Central America, and is included in the following enumeration:

Key to the North American species

Foliage densely pubescent.
- Inflorescence few-flowered on short peduncles. Mexican. 1. *C. velutinus*.
- Inflorescence many-flowered on long leafy peduncles. South American. 2. *C. sericeus*.

Foliage glabrous or nearly so. Mexican. 3. *C. Pringlei*.

1. **Calycobolus velutinus** (Mart. & Gal.)

Prevostea velutina Mart. & Gal. Bull. Acad. Brux. **12**[2]: 259. 1845.

Breweria mexicana Hemsley, Biol. Cent. Am. Bot. **2**: 400. 1882.

Porana velutina Hallier f. Bot. Jahrb. **16**: 538. 1893.

Softly pubescent, more or less erect and slender; leaf-blades oblong-lanceolate, thick, 5–7 cm. long, acute, the base obtuse or rounded; petioles 8–10 mm. long; peduncles about 2 cm. long, few-flowered: the three outer sepals about 15 mm. long, ovate, obtuse, glabrous at maturity, the two inner sepals subscarious and much smaller; corolla 2–2.5 cm. long, sparingly hirsute without; anthers oblong; ovary villous.

TYPE LOCALITY: "In Mexico inter Tehuacan et Oaxacan prope la Venta de Argon."

DISTRIBUTION: Southern Mexico.

2. **Calycobolus sericeus** (H.B.K.)

Dufourea sericea H.B.K. Nov. Gen. & Sp. **3**: 114. *pl. 114*. 1818.

Calycobolus emarginatus Willd.; R. & S. Syst. **5**: 4. 1819.

Reinwardtia sericea Spreng. Syst. **1**: 863. 1825.
Prevostea sericea Choisy, Ann. Sci. Nat. **4**: 496. 1825.

Distinguished from *C. velutinus* by its leaf-blades sericeous-pubescent beneath, the flower clusters ample and terminating leafy branches, and the colored outer sepals.

TYPE LOCALITY: "Crescit in Regno Novae Granatae, juxta urbem Mariquita, alt. 400 hex."

DISTRIBUTION: Northern South America.

3. **Calycobolus Pringlei** sp. nov.

Twining, 5 meters high, herbaceous above, woody below; glabrous except for some minute pubescence on the pedicels and at the base of the sepals; leaf-blades broadly lanceolate or oblong-lanceolate, acute, obtuse or rounded at the base, 4–8 cm. long, glabrous, texture somewhat rough and thick; petioles short, 5–10 mm. long; flowering branches one or more in the axils of the leaves, branching, many-flowered, leafy; pedicels 7–10 mm. long; the three outer sepals elliptical, rounded at the apex, 8–10 mm. long, the two inner ones 3 mm. long or less; corolla 1.5 cm. long and as broad, slightly pubescent in bud, becoming glabrous, deeply 5-lobed, lobes obovate, retuse; anthers short-sagittate, blunt.

MEXICO: On limestone hills, Yantepec, Morelos, alt. 4000 feet, *C. G. Pringle 8751*, November 21, 1903 (type, sheet no. *460794* in the Herbarium of the United States National Museum). Puebla, between Huajuapam, Oaxaca and Retlatzingo, *E. W. Nelson 1987*, November 19, 1894, alt. 4800–6500 feet.

The South American species in addition to *C. sericeus*, above mentioned, are as follows:

Calycobolus amazonicus (Choisy)

Prevostea amazonica Choisy, in DC. Prodr. **9**: 437. 1845.

Calycobolus ferrugineus (Choisy)

Prevostea ferruginea Choisy, Ann. Sci. Nat. **4**: 498. 1825.

Calycobolus glaber (H.B.K.)

Dufourea glabra H.B.K. Nov. Gen. & Sp. **3**: 114. 1818.
Calycobolus pulchellus Willd.; R. & S. Syst. **5**: 4. 1819.
Reinwardtia glabra Spreng. Syst. **1**: 863. 1825.
Prevostea glabra Choisy, Ann. Sci. Nat. **4**: 496. 1825.

Calycobolus spectabilis (Meissn.)

Prevostea spectabilis Meissn. in Mart. Fl. Bras. **7**: 325. 1869.

Calycobolus umbellatus (Choisy)

Prevostea umbellatus Choisy, Ann. Sci. Nat. **4**: 496. 1825.

2. BONAMIA Pet. Thouars, Hist. Veg. Afr. **1**: 17, 32. *pl. 5*. 1804 — J. St. Hil. Expos. Fam. **2**: 349. 1805.

Stout, spreading, herbaceous or sometimes woody or twining plants. Leaves herbaceous or subcoriaceous, rarely cordate. Sepals leathery or coriaceous, equal or nearly so, usually obtuse or rounded. Corolla large or medium-sized, white or blue, hirsute without on the plicae, the limb subentire. Filaments glandular-villous below. Ovary 2-celled, 4-ovuled. Style bifid nearly to the base, the divisions unequal; stigmas 2, globose. Capsules chartaceous, 4-valved. Seeds smooth, or pubescent on the dorsal angles.

Type species: *Bonamia alternifolia* J. St. Hil.

Breweria R. Br. Prodr. **1**: 487. 1810.

Trichantha Karst. & Triana, Linnaea **28**: 437. 1856.

About 30 species, chiefly in the tropics of the old world.

Key to the North American species

Sepals about 12 mm. long. Southwestern U. S. 1. *B. ovalifolia*.
Sepals 20 mm. long or longer; corolla 9–10 cm. long. Floridian. 2. *B. grandiflora*.

1. BONAMIA OVALIFOLIA (Torr.) Hallier f. Bot. Jahrb. **16**: 528. 1893

Evolvulus ovalifolia Torr. Bot. Mex. Bound. 150. 1859.

Breweria ovalifolia A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.

TYPE LOCALITY: Mexican side of the Rio Grande below San Carlos.

DISTRIBUTION: Arid regions of the Mexican boundary, Texas to New Mexico.

2. BONAMIA GRANDIFLORA (A. Gray) Hallier f. Bull. Herb. Boiss. **5**: 810. 1897

Breweria grandiflora A. Gray, Proc. Am. Acad. **15**: 49. 1880.

TYPE LOCALITY: Manatee and Sarasota, Florida.

DISTRIBUTION: In sandy soil, Florida.

The treatment of the genus *Stylisma* Raf. by various American authors has been the successive adoption of *Stylisma*, *Bonamia* and *Brewseria*, as the generic name of these plants. Dr. Gray first used *Stylisma*, and later took up *Bonamia* and *Brewseria* successively. The first edition of Chapman's Flora places the species under *Stylisma*, but in the latter editions *Brewseria* is adopted. All of these changes seem to be due to the fact that the Australian genus described by Brown has about the same character of style and ovary. A most important fact however seems to have been overlooked by those who have joined the American species of *Stylisma* to *Brewseria*, and that is that the genus *Brewseria* possesses a totally different habit and has comparatively stout, firm stems and branches, thick, firm or leathery obtuse or rounded sepals, points which serve to sharply separate the species of *Stylisma* from *Brewseria*. As has been shown by Hallier,* the genus *Brewseria* R. Br. is congeneric with *Bonamia* Thouars.

3. STYLISMA Raf. Neogenyt. 2. 1825. — Fl. Tellur. **4**: 55. 1836

Perennial, slender, weak, prostrate or somewhat twining plants, herbaceous above. Leaf-blades narrow or broad, entire, not cordate. Flowers 1–3, on axillary peduncles. Calyx pubescent or glabrous. Sepals equal or nearly so, herbaceous, pointed, somewhat united at the base. Corolla white, rotate or subfunnelform, the limb plaited, 5-angled or 5-lobed. Filaments filiform. Ovary 2-celled, 4-ovuled. Style divided nearly to the base, the divisions nearly equal. Stigmas 2, capitate. Capsules thin-walled, 2-celled, 2–4-valved. Seeds 2–4, glabrous or minutely pubescent.

Type species: *Stylisma peduncularis* Raf. = *Convolvulus humistratus* Walt. = *Stylisma humistrata* Chapm.

Six species in the southeastern United States and one in northern Mexico.

Key to the North American species

Sepals glabrous or merely ciliate.
  Leaf-blades narrowly linear. 1. *S. angustifolia.*
  Leaf-blades oblong. 2. *S. humistrata.*
Sepals distinctly pubescent.
  Filaments pubescent.
    Foliage sparingly pubescent; mature peduncles 1–3 cm. long; corolla 1.5 cm. long. 3. *S. trichosanthes.*

* Bot. Jahrb. **16**: 527, 573. 1893. — Bull. Herb. Boiss. **5**: 804. 1897.

Foliage densely brown-tomentose; mature peduncles 4–6 cm. long; corolla 2 cm. long. 4. *S. villosa.*

Filaments glabrous or nearly so.

Peduncles as long as the leaves or exceeding them.

Bracts exceeding the flowers; leaves linear. 5. *S. Pickeringii.*

Bracts not exceeding the flowers; leaves oblong to narrowly lanceolate. 6. *S. aquatica.*

Pedicels sessile in the axils and shorter than the round-ovate leaves. 7. *S. rotundifolia.*

1. **Stylisma angustifolia** (Nash)

Breweria angustifolia Nash, Bull. Torrey Club **22**: 155. 1895.

TYPE LOCALITY: Near Eustis, Florida.

DISTRIBUTION: Sandy soil in high pine lands, Florida.

2. STYLISMA HUMISTRATA (Walt.) Chapm. Fl. Southern U. S. 346. 1860

Convolvulus humistratus Walt. Fl. Car. 94. 1789.

Convolvulus tenellus Desr.; Lam. Encyl. **3**: 559. 1789. — Ell. Bot. S. C. & Ga. **1**: 215. 1817.

Convolvulus Sherardi Pursh, Fl. Am. Sept. **2**: 30. 1814.

Stylisma evolvuloides Choisy, Mém. Soc. Phys. Genèv. **6**: 494. 1833.

Stylisma pedunculare Raf. Fl. Tellur. **4**: 55. 1836.

Breweria Choisyana Steud. Nom. ed. 2. **1**: 224. 1840.

Bonamia humistrata A. Gray, Man. ed. 5. 376. 1867.

Breweria humistrata A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.

Breweria tenella Peter, in Engler & Prantl, Natürl. Pflanzenfam. **4**^{3a}: 16. 1901.

TYPE LOCALITY: Carolina.

DISTRIBUTION: Sandy soil, Virginia to Florida and Louisiana.

3. **Stylisma trichosanthes** (Michx.)

Convolvulus trichosanthes Michx. Fl. Bor. Am. **1**: 137. 1803.

Breweria trichosanthes Small, Fl. Southeastern U. S. 939. 1903.

TYPE LOCALITY: Carolina.

DISTRIBUTION: Sandy soil, North Carolina to Florida and Alabama.

4. **Stylisma villosa** (Nash)

Breweria villosa Nash, Bull. Torrey Club **22**: 159. 1895.

TYPE LOCALITY: Near Eustis, Florida.

DISTRIBUTION: Dry soil, peninsular Florida.

5. STYLISMA PICKERINGII (M. A. Curtis) A. Gray, Man. ed. 2. 335. 1856.

Convolvulus Pickeringii M. A. Curtis, Bost. Jour. Nat. Hist. **1**: 129. 1837.

Stylisma evolvuloides var. *angustifolia* Choisy, in DC. Prodr. **9**: 450. 1845.

Bonamia Pickeringii A. Gray, Man. ed. 5. 376. 1867.

Breweria Pickeringii A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.

TYPE LOCALITY: New Jersey.

DISTRIBUTION: Sandy pine regions, New Jersey to Florida, Mississippi and Texas. Also reported from Illinois.

6. STYLISMA AQUATICA (Walt.) Chapm. Fl. Southern U. S. 346. 1860.

Convolvulus aquaticus Walt. Fl. Car. 94. 1788.

Convolvulus erianthus Willd.; Spreng. Syst. **1**: 610. 1825.

Bonamia aquatica A. Gray, Man. ed. 5. 376. 1867.

Stylisma elliptica Raf. Fl. Tellur. **4**: 55. 1836.

Breweria aquatica A. Gray, Syn. Fl. N. Am. **2**: 217. 1878.

TYPE LOCALITY: Carolina.

DISTRIBUTION: In pine lands, Virginia to Florida and Texas.

7. **Stylisma rotundifolia** (S. Wats.)

Breweria rotundifolia S. Wats. Proc. Am. Acad. **23**: 281. 1888.

Evolvulus rotundifolius Hallier f. Bot. Jahrb. **16**: 530. 1893.

TYPE LOCALITY: Chihuahua, Sierra Madre, Mexico.

DISTRIBUTION: In fields and thickets, pine plains, northern Mexico. In general appearances this species has a striking similarity to certain species of *Evolvulus*, especially *E. prostratus* Robinson, but the style has only the two divisions, typical of *Stylisma*.

CLEMSON COLLEGE, SOUTH CAROLINA.

Notes on Carex — II

KENNETH KENT MACKENZIE

The species of *Carex* of the sub-genus *Vignea* are very numerous in North America, and are distinguished from one another by slight characters. The differences are often very hard to express in written descriptions, but when pointed out in the plants themselves are usually readily seen, and speaking in general terms the species are constant. The eastern species have become fairly well known, but there are many western forms which have only of late years begun to appear to any considerable extent in collections, and to four of these, all belonging to the section with the staminate flowers uppermost, the present paper will be devoted.

Carex austrina (Small) sp. nov.

Carex Muhlenbergii australis Olney; Bailey, Proc. Am. Acad. **22**: 141. 1886. Not *Carex australis* T. Kirk. 1894.

Carex Muhlenbergii austrinus Small, Fl. S. E. U. S. 218. 1903.

Culms erect, growing in strong clumps, 3–7 dm. high, the upper part roughened on the angles beneath the head, usually noticeably exceeding the upper leaves. Leaves with well-developed blades three to five to a culm, the blades ascending, 2.5–4 (rarely 4.5) mm. wide, 1–3 cm. long, glabrous, but roughened towards the apex and on the margins; spikes densely aggregated in a solitary terminal head, 15–30 mm. long, 8–15 mm. wide, the lower two to four distinguishable, each spike bearing the few inconspicuous staminate flowers above and the ten to many ascending perigynia below; bracts 1–5 cm. long, dilated and much nerved at the base, long-cuspidate and conspicuous; scales broadly ovate, white-hyaline, with several strong green ribs, strongly cuspidate, about as wide as and usually exceeding the perigynia, conspicuous; perigynia ascending, suborbicular, 4 mm. long, 3 mm. wide, greenish, rounded at base, abruptly narrowed into the serrulate, bidentate beak, which is about one-third the length of the body, nerveless or nearly so on the inner face, strongly nerved on the outer; achene lenticular, the face orbicular, 2.5 mm. long; stigmas two.

This species, which is apparently common from Missouri and Kansas through Arkansas and Oklahoma to Texas, was first named *Carex Muhlenbergii australis* by Olney in 1873 in Hall's *Plantae Texanae* (page 25), without description, and it does not seem to have been published with description until 1886 as cited above. It is quite distinct from *Carex Muhlenbergii* Schkuhr, and merits specific recognition fully as much as other members of this group. The characters separating the two species may be contrasted as follows:

Perigynia spreading, 3 mm. long; lower spikes strongly separated; bracts not broadly dilated at base; scales about the length of and narrower than the perigynia, short-awned. *C. Muhlenbergii.*

Perigynia ascending, 4 mm. long; lower spikes distinct, but not separated; bracts broadly dilated at base; scales (especially the lower in each spike) strongly awned, and exceeding and as wide as perigynia. *C. austrina.*

SPECIMENS EXAMINED:

MISSOURI: Sheffield, *Bush 1991*, June 6, 1904; Swan, *Bush 2936*, May 21, 1905; Sheffield, *Bush 1956*, May 28, 1904; Dodson, *Mackenzie*, May 10, 1896; Courtney, *Bush 2082*, July 9, 1904; Dodson, *Bush 1674*, May 14, 1902.

KANSAS: Bucklin, Ford County, *Hitchcock*, July, 1892.

ARKANSAS: Clay County, *Eggert*, May 25, 1893.

INDIAN TERRITORY: Sapulpa, *Bush 944* and *953*, May 6, 1895, and May 11, 1895; also *1288*, May 25, 1895; between Fort Cobb and Fort Arbuckle, *Palmer 367*, 1868.

TEXAS: Mineola, *Reverchon 2392*, April 22, 1901; Galveston, *Plank*, March 2, 1892; Dallas, *Reverchon 2885*, April 17, 1902; Corsicana, *Reverchon 3624*, April 14, 1903; Houston, *Hall 230*, April 10, 1872 (type); Belknap, *Hayes*, April 6, 1858.

Carex brevisquama sp. nov.

Culms erect, rather slender, roughened on the angles immediately beneath the head, 2.5–6 dm. high, much exceeding the leaves, growing in clumps, but the scaly rootstocks rather noticeably creeping. Leaves with well-developed blades about three to a culm and attached to its lower part only, the narrow blades erect or somewhat recurved, 8–30 cm. long, 1 mm. wide, roughened on the margins and especially towards the long-attenuate apex; spikes closely aggregated in a solitary, dense, terminal head, usually 15–

20 mm. long and about 7 mm. broad, the individual spikes poorly defined, and having from two or three to about ten ascending or somewhat spreading perigynia at the base of the rather inconspicuous terminal staminate flowers, which form a short cylinder; bracts absent, or occasionally the lowest one present, 8 mm. long or less, awl-shaped, long-attenuate; scales broadly triangular, hyaline, with the central portion brownish straw-colored, acuminate to short-cuspidate, noticeably exceeded by the perigynia; perigynia oblong-elliptical, 3.5 mm. long, 2 mm. wide, flat on the inner, rounded on the outer surface, the body round-tapering at base, margined on the inner surface towards the apex, and rounded and abruptly narrowed into the short, minutely serrulate, bidentate beak, which is about 1 mm. long, the body smooth, polished and nerveless; achenes lenticular, with orbicular face, 2 mm. long, 2 mm. wide; stigmas two.

Several specimens of this distinct plant have been collected within the last few years, and by some collectors have been named *Carex vallicola* Dewey. The original description of this last-named species, however, does not answer to our plant at all, but rather seems to indicate *Carex Hookeriana* Dewey, calling as it does for a plant with developed bracts and large scales. Our plant is readily distinguished from both *Carex Hookeriana* Dewey and its close relative *Carex occidentalis* Bailey by the scales being much shorter than and exposing the perigynia, while in the two species referred to the scales completely cover the perigynia or very nearly so.

SPECIMENS EXAMINED:

WYOMING: Red Desert, Orendo Butte, Sweetwater County, *A. Nelson 7124*, June 11, 1900 (type, in Herb. N. Y. Bot. Gard.); Evanston, *A. Nelson 3000*, May 29, 1897 (very young); Leucite Hills, *Merrill & Wilcox 487*, June 17, 1901.

OREGON: North Pine Creek near Snake River, *Cusick 2519*, May 24, 1901.

Carex neomexicana sp. nov.

Culms erect, growing in small clumps, 2.5–4 dm. high, much exceeding the leaves, which are clustered towards the base, roughened on the angles, especially above. Leaves with well-developed blades about three to a culm, the blades erect-ascending, 1.5–2.5 mm. wide, 1–3 dm. long, roughened, especially on the margins; spikes few (about five), all aggregated into a rather stiff head 1.5–2.5 cm. long and about 1 cm. wide, the upper spikes not distinguishable, the lower readily distinguishable but little separated,

each spike bearing the rather inconspicuous staminate flowers above and the 1–5 ascending perigynia beneath; bracts (except the lowest) inconspicuous and resembling the scales, the lowest bract exceeding its spike, 1 cm. long, slightly enlarged at base and terminating in a long cusp; scales ovate-triangular, the bodies whitish with green midrib, acuminate to cuspidate, about the width of and rather shorter than the perigynia, which are not completely concealed; perigynia ovate-lanceolate, flat on the inner and rounded on the outer surface, glabrous, usually nerved on both surfaces, the whole 4 mm. long, the body about 1.7 mm. wide, tapering at base, scarcely stipitate, tapering somewhat abruptly into the slightly to strongly roughened, strongly bidentate, beak, which is barely 1 mm. long and only one-third the length of the body; achenes lenticular, with short-oblong face, 2.75 mm. long, 1.5 mm. wide; stigmas two.

Dr. Boott long ago noticed that this plant is distinct from *Carex Hookeriana* Dewey, a note in his handwriting attached to one of the Santa Rita specimens of Bigelow cited below and preserved in the Torrey Herbarium calling attention to the fact that it has nerved perigynia, while *Carex Hookeriana* has nerveless perigynia. More complete specimens collected since this note was written have disclosed the fact that other differences exist, which separate this plant from *Carex Hookeriana* as well as from *Carex occidentalis* Bailey. Summarized, the more important distinctions may be contrasted as follows:

Spikes with 1–5 perigynia, the latter 4 mm. long, usually nerved on the inner face; scales whitish, not concealing the perigynia.	*C. neomexicana.*
Spikes with 5–10 perigynia, the latter 2.5–3.5 mm. long, nerveless on the inner face; scales strongly tinged with brown, nearly or quite concealing the perigynia.	*C. Hookeriana.* *C. occidentalis.*

SPECIMENS EXAMINED:

ARIZONA: Yavapai County, *Rusby 859*, 1883; also *855*.

NEW MEXICO: *Wright 1952*, 1851–2; "New Mexico" *Dewey*; Santa Rita del Cobra on the Rio Mimbras, *Bigelow 1547* (type, in Herb. Columbia College).

Carex tumulicola sp. nov.

Culms erect, growing in strong clumps, 4.5–8 dm. high, exceeding the leaves, roughened on the angles, especially above. Leaves with well-developed blades about three or four to a culm,

the blades erect-ascending, 1.5–2.5 mm. wide, 1–3 dm. long, roughened, especially on the margins; spikes five to ten, the lower three to six separate, the upper aggregated and undistinguishable, the whole head slender and often rather flexuous, 2–5 cm. long and less than 1 cm. wide, each spike bearing the few staminate flowers above and the few (10 or less) ascending perigynia beneath; bracts, especially the lower, well-developed, somewhat enlarged at base, prolonged into a long cusp, usually or often exceeding their spikes, and the lowest often exceeding the head; scales ovate-triangular, brownish straw-colored with opaque margin and green mid-rib, acuminate to cuspidate, rather wider and from slightly longer to slightly shorter than and largely concealing the perigynia; perigynia lanceolate, flat on the inner and rounded on the outer surface, glabrous, nerved on both surfaces, especially strongly on the inner, the whole 5 mm. long, the body 1.5 mm. wide, margined above, round tapering at base into a stipe 0.5 mm. long and rather gradually contracted into a rough bidentate beak, which is about one-third the length of the body; achenes lenticular with short-oblong face, 3.25 mm. long, 1.5 mm. wide; stigmas two.

Related to the northern and high mountain *Carex Hookeriana* Dewey, this species seems to take its place in the foothills southerly and easterly of San Francisco, from which region have come all the specimens I have seen. It is quickly distinguished from that plant, as follows:

Perigynia nerveless on inner surface, 3.5 mm. long or less.	*C. Hookeriana.*
Perigynia strongly nerved on inner surface, 5 mm. long.	*C. tumulicola.*

SPECIMENS EXAMINED:

CALIFORNIA: Lake Temescal, Alameda county, *Bioletti*, June 25, 1893 (type, in Herb. Columbia College); Oakland, *Bolander*; Los Gatos, Santa Clara County, *Heller 7309*, April 12, 1904.

Two new willows from the Canadian Rocky Mountains*

WILLARD WINFIELD ROWLEE

During the summer of 1899, Mr. W. C. McCalla spent several months exploring and collecting in the vicinity of Banff, Alberta. At the writer's suggestion he made a special effort to secure a set of willows of the region, in which the stages of development would be shown. Usually collectors have too little time at their disposal to label or otherwise mark individuals in the field and then to go over the ground a second or third time and supplement their first collection, a method very essential in making specimens of *Salix*. Mr. McCalla not only did this but was also well equipped by natural aptitude and previous study to carry on a thorough investigation of the flora. The result of his work was an admirable and valuable set of plants from a region heretofore imperfectly know. Mr. Ball has already recognized, among McCalla's willows, specimens representing his new species, *Salix wyomingensis*. Two other specimens appear to represent new species of *Salix*.

Salix albertana sp. nov.

Low stout shrub; shoots of current and preceding year dark-brown, covered with sparse cobweb-like pubescence, roughened by the leaf-scars and the more or less persistent scales; buds small, brown; leaves broadly elliptic-lanceolate, tapering equally to both ends, minutely glandular-serrulate or entire, clothed both sides with dense appressed silky tomentum when young, becoming less so with age, markedly opaque, petiole stout, 0.5–0.75 cm. long, blade 6–7 cm. long, the broadest 2.5 cm. wide, midrib and primaries prominent, ultimate veins distinctly reticulate; stipules large, the largest 0.75 cm. long, and 0.5 cm. wide, obscurely glandular denticulate, semi-persistent; aments large, sessile, terminal, usually in pairs, appearing before the leaves, silky and densely flowered; pistillate cylindrical, 5–6 cm. long, 1.5 cm. thick, remaining dense at maturity; scale black, nearly equaling the ovary at anthesis, elliptic, obtuse, clothed on the back and margins with long silky hairs; capsule lanceolate, silky-pubescent, sessile, tapering into the long

* Contribution No. 122 from the Botanical Department of Cornell University.

(2 mm.) style which is deeply divided, each division bifid; gland large; stamens 2, filaments glabrous.

The type of this species is Mr. McCalla's *2251*, collected in Alberta, British Columbia, on the "higher mountain slopes in rather wet ground (alt. 6500–7800 ft.), June 30, July 18, and August 30, 1899." Our specimens still retain the balsamic odor which in the fresh plant was as "strong as that of Balm of Gilead, and much like it."

It is quite probable that our species is *S. Barrattiana* var. *angustifolia* Anders. in DC. Prodr. **16**[2]: 247. In floral characters it is much like *S. Barrattiana* Hooker, as understood by Mr. Bebb and subsequent students, but differs fundamentally in form and vesture of the leaf. One (both are marked "B") of the two pistillate leafy twigs represented in Hooker's plate of *S. Barrattiana* seems to have been based on this shrub. The other pistillate leafy twig, the details of leaf and floral structure, and the description, apply to *S. Barrattiana*, which has "leaves cordate at the base."

Present knowledge would therefore indicate that three species may be recognized in connection with the *Barrattiana* group: *S. Barrattiana* Hooker and *S. Tweedyi* (Bebb) Ball, both of which have leaves thin and green and cordate at the base, but differ in that the former has leaves and capsules with a conspicuous silky vesture; *S. albertana* has thick opaque leaves, acute at the base and apex and agrees with *S. Barrattiana* in vesture. All three have styles and stigmas which are characteristic and all have the same peculiar glands on the margins of the stipules and leaf-blades.

Salix Maccalliana sp. nov.

Shrub 1–2 meters high. Young shoots and leaves minntely puberulent, soon becoming glabrous throughout; bark upon older branches dark-brown; buds yellow, rather large, flattened, pointed; leaves elliptic-lanceolate, 6–7 cm. long, 1.5 cm. wide, tapering equally to both ends, green and glabrous on both sides at maturity, finely but distinctly serrate, the serrations terminating in a characteristic callus, petioles 0.5–0.75 cm. long, the petiole, midrib and primary veins light-yellowish and in strong contrast to the green of the rest of the leaf which is obscurely reticulately veiny both sides; stipules none; aments borne on short leafy peduncles, the axis and the upper part of the peduncle hoary-canescent; flowers densely aggregated in the ament at anthesis, the pistillate

becoming more lax as the capsules mature; scale membranous and green at first, becoming tawny, with 3 or 4 prominent parallel veins, oblong, more than twice the length of the pedicel, rounded at the apex, crisp-hairy on the back; capsule large, prominently rostrate, clothed with short spreading silky hairs, about 8 mm. long at maturity, pedicel short (1 mm.), about twice the length of the yellow gland; style glabrous, 1 mm. long, surmounted by four stout stigmas; style and stigmas reddish-brown; stamens 2, filaments with a few spreading hairs at the base.

This beautiful shrub is obviously related to *Salix glaucops* Anders., but differs in having glabrous serrate leaves. Its leaves and buds suggest *S. lucida.*

McCalla 2252a (pistillate), *McCalla 2252* (staminate), type. Both collected in Alberta, British Columbia, at alt. 4500 feet, the former "at water's edge along road to Sun Dance Cañon, July 10, 1899"; the latter on "low ground along road to Devil's Head Lake, June 19 and August 19, 1899."

INDEX TO AMERICAN BOTANICAL LITERATURE

(1907)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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